



Unified Telemetry

Building an infrastructure for
Big Data in Games Development

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Technical Architect, Ubisoft Montreal

Agenda

- Intro
- Unified Telemetry Rationale and Design
- RainbowSix|Siege Telemetry
- Postmortem
- Q&A

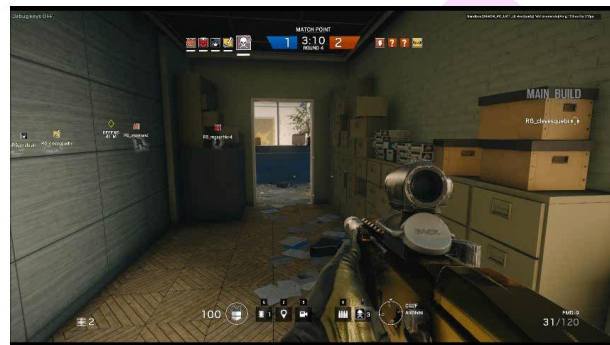
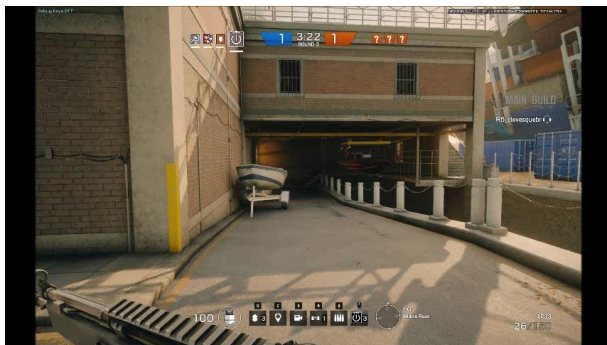
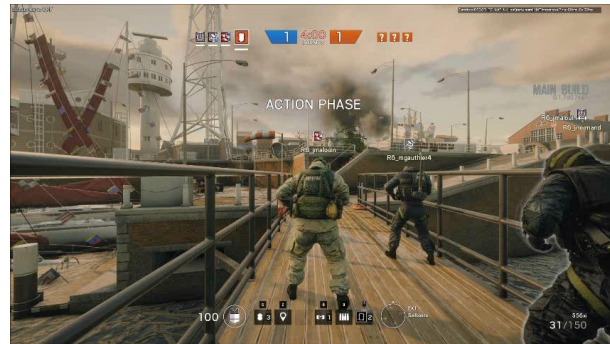




Rainbow Six|Siege

- Competitive Multiplayer Shooter
- Next Gen Only
- Fully Destructible Environments
 - Check out our [RealBlast Talk](#) on GDC16 Vault
- Heavily Multithreaded

Rainbow Six|Siege - Multiplayer



Rainbow Six|Siege - Game Server

- Dedicated Servers
- Hosted on Microsoft's Xbox Live Cloud
 - Azure (mostly)
 - No Remote Debugging ☹️
- Outside Ubisoft Internal Network



Problem

- How to profile/debug a game that:
 - Runs client-side code on 10 machines
 - Runs server-side code on a cloud-hosted VM
 - Is a live online service
 - Developed and tested by hundreds of devs
 - At several locations worldwide

Old Workflow

- Instrument/Record:
 - Logs
 - Profile Points
 - Functional Scopes
 - Function Callstacks
 - Memory Snapshots
 - Memory Alloc/Free
 - Network Replication
 - Network Bandwidth
 - Size of Buffers
 - Particles
 - Gameplay Events
 - Structured Data
 - Resource Activity
 - and more...

Old Workflow

- Run the game locally
- Play it yourself
- Try to reproduce the issue
- Investigate
- Rinse & Repeat



Old Workflow for multiplayer

- Run multiple instances locally
- “Play” some of them
- Try to reproduce the issue
- Investigate
- Doesn't Work for profiling and timing related bugs ☹

Telemetry Powered Workflow

- Instrument/Record:
 - Logs
 - Profile Points
 - Functional Scopes
 - Function Callstacks
 - Memory Snapshots
 - Memory Alloc/Free
 - Network Replication
 - Network Bandwidth
 - Size of Buffers
 - Particles
 - Gameplay Events
 - Structured Data
 - Resource Activity
 - and more...

Telemetry Powered Workflow

- Always-on Recording
- Every engine/tool instance
- Every developer
- Everywhere
- Every Platform
- Automatically Collected Remotely
- Post Processed & Stored Centrally



HUBBLE AN EYE ON PRODUCTION

Refresh Jira Refresh Mongo ?

160706 issues retrieved on 20/01/2016 10:47:10

Web Browser Calendar FSO Jira Bloomberg Asset Bank Mongo Stats Build

Cell: All Date: 01/18/2016 Map: All Platform: PS4 Target: Engine - Profile

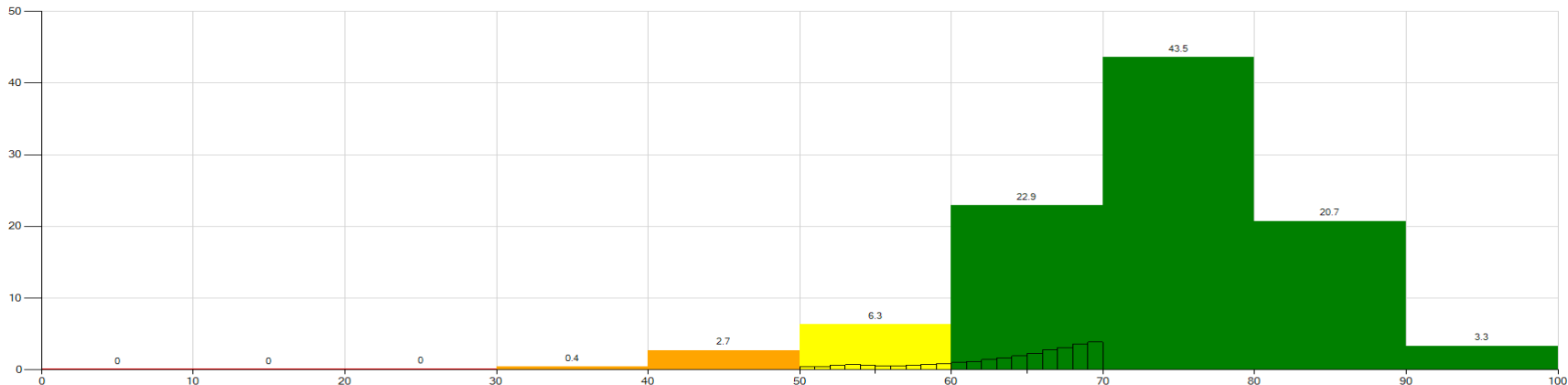
More Clear Favorites...

Settings... Export...





| User | Platform | Target | Changelist | Map | Game Type | Game Mode | Role | Xic | Session Name | Players Count | Play Time | Date | Median FPS | Below 60 FPS | Files | Id | Continuous |
|------------------|----------|------------------|------------|---------------|-----------|-------------------|--------|-------|--------------|---------------|-----------|------------------|------------|--------------|-------|--------------------|------------|
| mmandici | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB | Client | False | 10 | 0:00:15.42 | 75.06 | 01/18/2016 03:34 | 75.06 | 0.26 | 0 | 5ef446e1-bdbc-1... | 0 |
| mpaltena | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB | Client | False | 10 | 0:00:15.405 | 73.82 | 01/18/2016 03:36 | 73.82 | 0.36 | 0 | 93c717dbdc-1... | 0 |
| sharalanbie | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB | Client | False | 10 | 0:04:05.209 | 74.11 | 01/18/2016 03:46 | 74.11 | 3.60 | 0 | 56d8e0a1-bdbe... | 0 |
| mmandici | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB | Client | False | 10 | 0:04:05.256 | 74.34 | 01/18/2016 03:47 | 74.34 | 2.86 | 0 | 6e7fbb6-bdbc-1... | 0 |
| arcturus1801 | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB | Client | False | 10 | 0:00:15.402 | 74.49 | 01/18/2016 03:51 | 74.49 | 0.44 | 0 | a1abb28d-bdbf-1... | 0 |
| bcaionescu | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB | Client | False | 10 | 0:00:15.414 | 71.52 | 01/18/2016 03:54 | 71.52 | 0.46 | 0 | f3932a25-bdbf-1... | 0 |
| arcturus1801 | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB | Client | False | 10 | 0:03:52.887 | 73.68 | 01/18/2016 04:03 | 73.68 | 5.19 | 0 | ad89932b-bdc0-... | 0 |
| aebnatu | PS4 | Engine - Profile | 1649602 | OREGON | PvP | TDM - HOSTAGE | Client | False | 10 | 0:03:06.034 | 78.24 | 01/18/2016 04:19 | 78.24 | 0.55 | 0 | e500bc01-bdc0-... | 0 |
| mpaltena | PS4 | Engine - Profile | 1649602 | OREGON | PvP | TDM - HOSTAGE | Client | False | 10 | 0:02:23.532 | 76.45 | 01/18/2016 04:20 | 76.45 | 0.16 | 0 | e489e647-bdc3-... | 0 |
| lon-Ovidiu An... | PS4 | Engine - Profile | 1649602 | OREGON | PvP | TDM - HOSTAGE | Client | False | 10 | 0:03:49.29 | 80.19 | 01/18/2016 04:21 | 80.19 | 0.26 | 0 | 5ae5a828-bdc3-... | 0 |
| arcturus1801 | PS4 | Engine - Profile | 1649602 | OREGON | PvP | TDM - HOSTAGE | Client | False | 10 | 0:03:49.645 | 79.23 | 01/18/2016 04:35 | 79.23 | 0.80 | 0 | 237b49db-bdc3-1... | 0 |
| bcaionescu | PS4 | Engine - Profile | 1649602 | OREGON | PvP | TDM - HOSTAGE | Client | False | 10 | 0:03:49.645 | 78.39 | 01/18/2016 04:38 | 78.39 | 0.68 | 0 | e5725554-bdc5-... | 0 |
| mmandici | PS4 | Engine - Profile | 1649602 | HEREFORD BASE | PvP | TDM - SECURE AREA | Client | False | 10 | 0:03:17.24 | 73.40 | 01/18/2016 04:47 | 73.40 | 0.61 | 0 | 6083a10b-bdc5-... | 0 |
| mpaltena | PS4 | Engine - Profile | 1649602 | HEREFORD BASE | PvP | TDM - SECURE AREA | Client | False | 10 | 0:03:24.929 | 78.42 | 01/18/2016 04:49 | 78.42 | 0.33 | 0 | 94245cb-bdc5-1... | 0 |
| acion | PS4 | Engine - Profile | 1649602 | HEREFORD BASE | PvP | TDM - SECURE AREA | Client | False | 10 | 0:02:44.746 | 79.21 | 01/18/2016 04:51 | 79.21 | 0.26 | 0 | f313ab5c-bdc7-1... | 0 |
| mpaltena | PS4 | Engine - Profile | 1649602 | HEREFORD BASE | PvP | TDM - SECURE AREA | Client | False | 10 | 0:02:25.825 | 76.72 | 01/18/2016 05:06 | 76.72 | 0.26 | 0 | 12f3ca03-bdc8-1... | 0 |

FPS Performance Budgets

FPS HISTOGRAM











6 HUBBLE AN EYE ON PRODUCTION

 Web Browser  Calendar  FSO  Jira  Bloomberg  Asset Bank  Mongo Stats  Build

Cell: ▼ Date: ▼ Map: ▼ Platform: ▼ Target: ▼
All 01/18/2016 All PS4 Engine - Profile

 Stats  Trends

| User | Platform | Target | Changelist | Map | Game Type | Game Mode |
|--|----------|------------------|------------|--------|-----------|---------------|
|  mmandici | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB |
|  pmpaltenea | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB |
|  aharalambie | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB |
|  mmandici | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB |
|  arcturus1801 | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB |
|  bcaionescu | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB |
|  arcturus1801 | PS4 | Engine - Profile | 1649602 | HOUSE | PvP | TDM - BOMB |
|  aebratu | PS4 | Engine - Profile | 1649602 | OREGON | PvP | TDM - HOSTAGE |

Search...

Q

+

+

+

r6_telemetry_logs

12,914,781 hits

Selected Fields

line
file
message
category
username

Available Fields

Popular

_index

tags

thread_id

_id

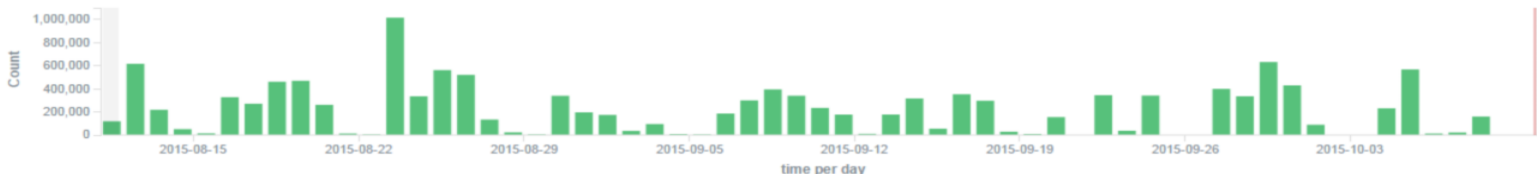
_type

message_string

session_id

time

type

August 12th 2015, 15:43:45.831 - October 11th 2015, 15:43:45.831 — [by day](#)

| Time | message | category | file | line | username |
|--------------------------------|---|----------|--|------|--------------|
| October 9th 2015, 15:14:11.448 | [DisabledComponentUpdated][QueueComponent] Requested update for Component ActiveGroundDrone which was inactive. Owner={object: UNKNOWN id=0xf000a027 class=Entity} | - | - | 0 | mdepascale |
| October 9th 2015, 12:40:19.171 | *****Kino Peak Allocation Type [0] peak allocation [9] waste [247] Type [1] peak allocation [0] waste [8] Type [2] peak allocation [0] waste [0] Type [3] peak allocation [116] waste [4384] Type [4] peak allocation [43] waste [981] | Scimitar | e:\rainbow6\osborn\main\framework\source\scimitar\engine\animation\atom\atominstancepool.cpp | 685 | sorin.ivascu |
| October 9th 2015, 12:40:19.168 | This class has been tagged with the skipreleaseresources mold attribute. ReleaseResources() should not be called. 1. Check if the class should really have this attribute(see programmer guide for guidelines). 2. If still needed, add the attribute to the referenced property. | Scimitar | e:\rainbow6\osborn\main\framework\source\scimitar\engine\debug\replay\debugreplaydebugdisplaytrack.cpp | 731 | sorin.ivascu |
| October 9th 2015, 12:40:18.055 | Shutdown() | Shaders | e:\rainbow6\osborn\main\framework\source\scimitar\graphic\ekion\ekshaderdatabase manager.cpp | 412 | sorin.ivascu |
| October 9th 2015, 12:40:18.051 | Pilot shutdown | Pilot | e:\rainbow6\osborn\main\framework\source\scimitar\engine\ai\pilot\pilotfacade.cpp | 476 | sorin.ivascu |

kibana

Discover

Visualize

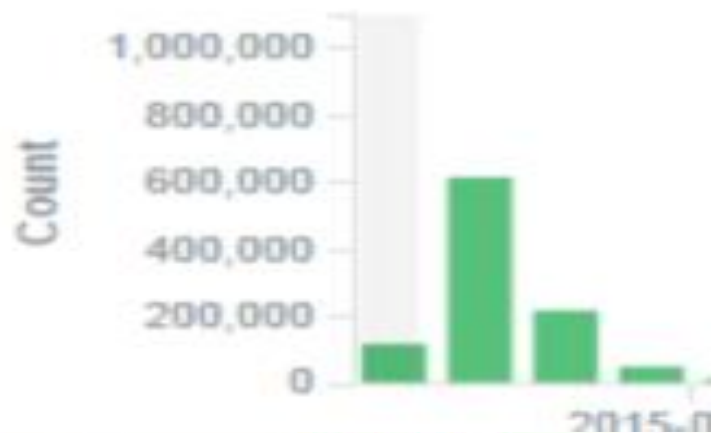
Dashboard

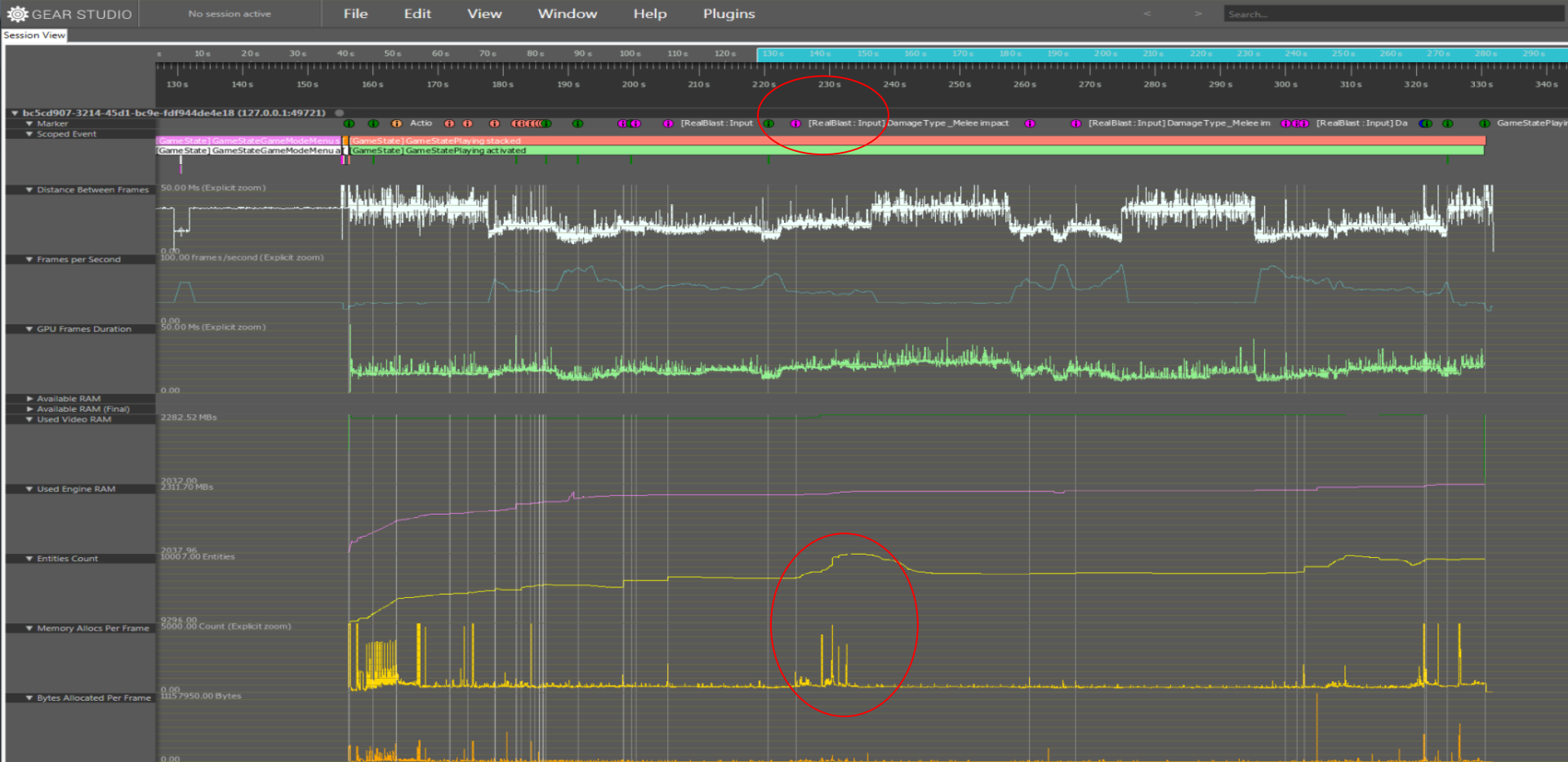
Search...

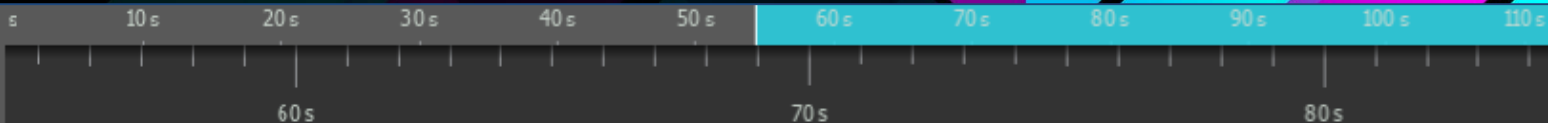
r6_telemetry_logs

Selected Fields

- # line
- file
- message
- category
- username







▼ 19847bfd-bb5f-11e5-ac49-00d9d1d0f0b5_0 estambulitchi PS4 Engine - Profile C1647491_D260330_S0_8455798 BUC_PERF_CAPTURES round 0 ●

▼ Marker

[Telemetry] [RealBlast: Input] Damage Type_Melee impact at (x=19. [Real

▼ Scoped Event

[Game State] GameStatePlaying stacked

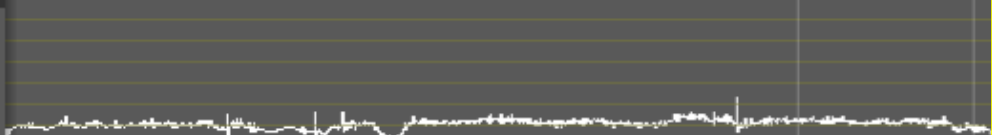
[Game State] GameStatePlaying activated

[Telemetry] streaming /app0/2016.01.15-03.18.10_slow_fra

[Slow] [Telemetry] streamin

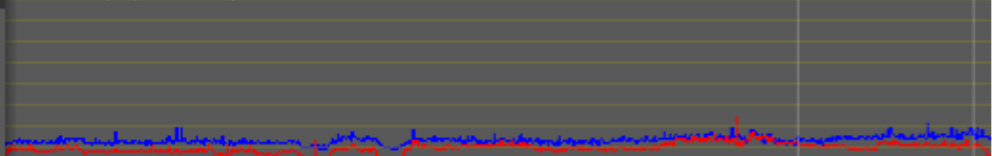
▼ CPU Frames

50.00 Ms (Explicit zoom)



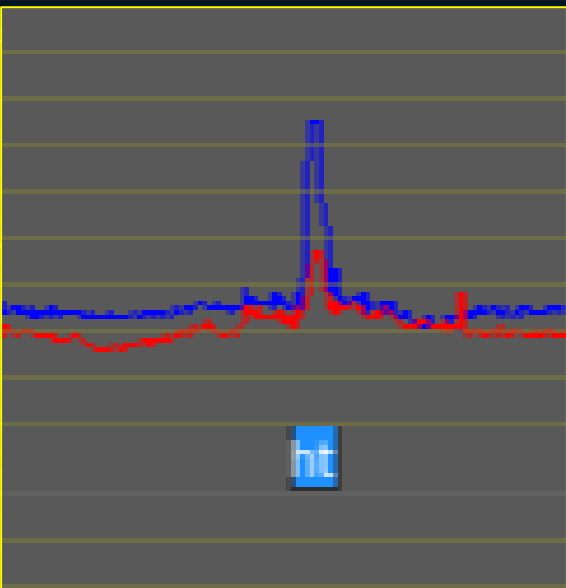
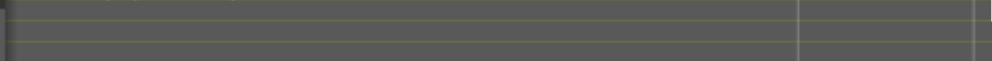
▼ CPU Updates

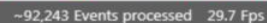
0.00
50.00 Ms (Explicit zoom)



▼ GPU Updates

0.00
50.00 Ms (Explicit zoom)





Memento

File Edit View Tools Window Debug Help

Explorer

PVP01_Housebox_V2.memstats

| | |
|------------------------------|---------------|
| 16/03/2015 10:26:26 AM | |
| Cell Snapshots (2) Unknown | |
| GraphicResources Snapshot 01 | 5,573,195,594 |
| GraphicResources Snapshot 02 | 2,076,066,080 |
| 14/04/2015 2:45:46 PM | |
| Cell Snapshots (4) Unknown | |
| Snapshot 01 | 0 |
| GraphicResources Snapshot 01 | 1,246,072,191 |
| Snapshot 02 | 0 |
| GraphicResources Snapshot 02 | 1,289,992,072 |
| 14/04/2015 4:03:51 PM | |
| Cell Snapshots (4) Unknown | |
| Snapshot 01 | 4,790,138,535 |
| GraphicResources Snapshot 01 | 1,266,069,921 |
| Snapshot 02 | 4,891,367,946 |
| GraphicResources Snapshot 02 | 1,276,672,112 |
| 23/04/2015 11:21:10 AM | |
| Cell Snapshots (8) Unknown | |
| Snapshot 01 | 5,203,799,012 |
| GraphicResources Snapshot 01 | 1,454,153,465 |
| Snapshot 02 | 5,288,395,068 |
| GraphicResources Snapshot 02 | 1,475,085,111 |
| Snapshot 03 | 5,324,588,348 |
| GraphicResources Snapshot 03 | 1,481,412,263 |
| Snapshot 04 | 5,369,505,786 |
| GraphicResources Snapshot 04 | 1,484,838,729 |

Snapshots taken in
one play session

General

| | |
|------------------|---|
| Branch: | //osborn/main/ |
| ChangeList: | 1,280,830 |
| Command line: | /fast /skipmps:1 /logoutputfolder:D:/mentag d211553 |
| Data changelist: | |

Snapshot 04

| Name | Used Size | SubTree % | % | Waste | # Allocations |
|----------------------------|---------------|-----------|---------|------------|---------------|
| Snapshot 04 | 5,369,505,786 | | 100.0 % | 41,497,484 | 2190674 |
| Graphic | 2,776,940,074 | | 52.1 % | 2,940,023 | 607050 |
| Sound | 852,009,860 | | 16.0 % | 382,330 | 2904 |
| Data | 848,324,436 | | 15.7 % | 13,256,626 | 924459 |
| Entity | 494,417,620 | | 58.4 % | 6,936,019 | 554802 |
| Animation | 135,071,268 | | 16.0 % | 1,711,889 | 23365 |
| MeshShape | 65,987,404 | | 7.8 % | 1,008,731 | 8152 |
| Physic | 53,853,648 | | 81.5 % | 869,744 | 53 |
| MeshShape | 12,064,156 | | 18.4 % | 135,448 | 6964 |
| m_Vertices(subVector4) | 7,306,112 | | 60.5 % | 90,768 | 1135 |
| m_IndicesTriangleList | 3,335,468 | | 27.8 % | 18,530 | 1135 |
| <MeshShape> | 799,280 | | 6.5 % | 18,400 | 1135 |
| m_IndicesMaterial(u... | 591,040 | | 4.9 % | 7,734 | 1135 |
| MeshShapeWrapper | 18,160 | | 0.2 % | 0 | 1135 |
| m_Materials(Refere... | 12,608 | | 0.1 % | 16 | 1135 |
| m_OverrideCollision... | 1,488 | | 0.0 % | 0 | 154 |
| SimpleStringTemplate | 69,600 | | 0.1 % | 3,539 | 1135 |
| DestructionData | 34,398,912 | | 4.1 % | 515,034 | 31715 |
| Mesh | 25,439,496 | | 2.9 % | 1,034,822 | 5595 |
| World | 25,014,784 | | 3.0 % | 279,560 | 1701 |
| ProceduralMesh | 24,146,596 | | 2.9 % | 284,172 | 25280 |
| Init | 12,340,728 | | 1.5 % | 189,925 | 11676 |
| AtomGraph | 11,617,040 | | 1.3 % | 631,826 | 111767 |
| LocalizationComponent | 6,188,320 | | 0.7 % | 196,512 | 61220 |
| SplashFX | 1,558,504 | | 0.2 % | 64,236 | 7697 |
| MergedDestructionHierarchy | 1,142,328 | | 0.1 % | 15,888 | 583 |
| Material | 990,624 | | 0.1 % | 13,177 | 1623 |
| TextureMap | 732,940 | | 0.1 % | 55,976 | 7755 |
| LocalizationPackage | 729,552 | | 0.1 % | 64,828 | 4 |
| Skeleton | 615,704 | | 0.1 % | 9,916 | 7320 |
| FireData | 601,656 | | 0.1 % | 735 | 99 |
| SoundPropagationMap | 579,256 | | 0.1 % | 18,232 | 1845 |

Snapshot tags

Classification

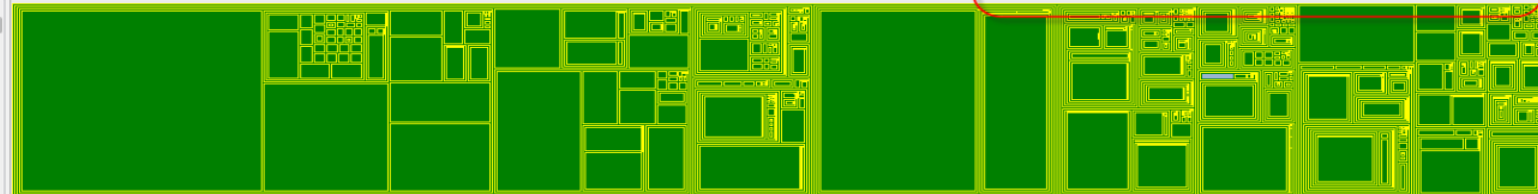
Budget

| Name | Budget | Used Size |
|---|-----------|-----------|
| [Budget context: default] | -2,048.00 | 0.00 |
| Unclassified | 150.00 | 107.02 |
| [Data] 3D - Meshes | 266.00 | 273.39 |
| [Data] 3D - Particles | 32.00 | 42.24 |
| [Data] 3D - Textures | 1,443.00 | 1,370.09 |
| Textures | 1,443.00 | 1,370.09 |
| Graphic: PhysMem:Texture: RC_Unknown | | 130.28 |
| Graphic: PhysMem:Texture: RC_Unknown | | 130.19 |
| Graphic: PhysMem:Texture: RC_Unknown:... | | 0.09 |
| Graphic: PhysMem:Texture: RC_Environment | | 820.38 |
| Graphic: PhysMem:Texture: RC_Character | | 259.94 |
| Graphic: PhysMem:Texture: RC_Illegal | | 26.00 |
| Graphic: PhysMem:Texture: RC_FX | | 79.63 |
| Graphic: PhysMem:Texture: RC_Interface | | 0.38 |
| Graphic: PhysMem:Texture: GFX(TextureArrayMa... | | 53.44 |
| Graphic: PhysMem:Texture: RC_Gameplay | | 0.00 |
| [Data] Animation | 190.00 | 294.15 |
| [Data] Destruction | 200.00 | 282.35 |
| [Data] Entities | 80.00 | 90.87 |
| [Data] Localization | 20.00 | 5.90 |
| [Data] Sound | 700.00 | 810.39 |
| [Engine] 3D - Buffers | 212.00 | 183.60 |
| [Engine] 3D - Misc | 300.00 | 465.85 |
| [Engine] 3D - Textures | 373.00 | 375.06 |
| [Engine] Animation | 55.00 | 53.92 |
| [Engine] Debug | 0.00 | 116.18 |
| [Engine] Destruction | 150.00 | 148.54 |
| [Engine] Fire | 25.00 | 37.64 |
| [Engine] Physics | 220.00 | 270.86 |
| [Engine] Pilot | 55.00 | 50.58 |

Snapshot tags classified under budgets

Tree Map

m_Vertices(subVector4)



Data: MeshShape:MeshShape:m_Vertices(subVector4)

Label

Telemetry Monitor

ApplicationConnectionsFileLog

Show only worst frameShow reversed callstackSearch

| Name | Count | Bytes |
|---|---------|----------|
| scimitar:SimpleStringTemplate<char,1>::Assign+0x21A | 2581659 | 43945110 |
| scimitar:AtomGraphNode::UpdateEditorProfiler+100B27F (f:\w1\osborn\main\framework\source\scimitar\engine\animation\atom\atomgraphnode.cpp:827) | 766224 | 9722879 |
| scimitar:AtomNodeProfileData::AtomNodeProfileData+0x152 | 766224 | 9722879 |
| scimitar:IKUtils::AddIKSolveBoneKlob+0x05 | 435929 | 4795219 |
| scimitar:WorldInformation::SetLastXUpdated+73518B (f:\w1\osborn\main\framework\source\scimitar\engine\worldinformation.cpp:77) | 186060 | 4733685 |
| scimitar:CharacterTask::UpdateAnimPrePhysics_Equipment+8FA2C2 (f:\w1\osborn\main\framework\source\scimitar\engine\scheduler\characterscheduler.cpp:404) | 123218 | 7269862 |
| scimitar:IKUtils::AddIKSolveBoneKlob+0x01 | 109995 | 1209945 |
| scimitar:SimpleStringTemplate<char,1>::operator+=+4633D6 (f:\w1\osborn\main\framework\source\scimitar\system\containers\simplestring.cpp:129) | 20653 | 954796 |
| scimitar:IKUtils::AddIKSolveBoneKlob+0x113 | 18554 | 204094 |
| scimitar:PhysMemTracker::GetIndexAndContext+0x119 | 15450 | 197485 |
| scimitar:PhysMemTracker::InternAdd+2206A5 (f:\w1\osborn\main\framework\source\scimitar\system\memory\physmemtracker.cpp:121) | 15450 | 197485 |
| scimitar:PhysMemTracker::Add+221D10 (f:\w1\osborn\main\framework\source\scimitar\system\memory\physmemtracker.cpp:36) | 9802 | 104576 |
| scimitar:DX11ResourceBuffer::Base::Create+1911115 (f:\w1\osborn\main\framework\source\scimitar\graphic\gfx\dx11\dx11resourcebuffer.cpp:49) | 9774 | 103662 |
| scimitar:DX11ConstantBuffer::DX11ConstantBuffer+1912092 (f:\w1\osborn\main\framework\source\scimitar\graphic\gfx\dx11\dx11resources.cpp:193) | 9700 | 102644 |
| scimitar:DX11VertexBuffer::DX11VertexBuffer+1911B60 (f:\w1\osborn\main\framework\source\scimitar\graphic\gfx\dx11\dx11resources.cpp:68) | 38 | 518 |
| scimitar:DX11Device::CreateVertexBuffer+0x09 | 38 | 518 |
| scimitar:GFXStaticMesh::CreateRegularVABAndIB+0x68 | 24 | 328 |
| scimitar:GFXDynamicSubMeshInstances::GFXDynamicSubMeshInstance+0x4A1 | 12 | 172 |
| scimitar:GFXGraphicObjectFactory::CreateObjectInstance+0x58E | 12 | 172 |
| scimitar:GraphicManagers::CreateHardwareGraphicObjectInstance+0x19 | 12 | 172 |
| This function as root | 12 | 172 |
| scimitar:IKGridGeometry::GenerateGrid+0x131 | 2 | 18 |
| scimitar:DX11IndexBuffer::DX11IndexBuffer+1911E68 (f:\w1\osborn\main\framework\source\scimitar\graphic\gfx\dx11\dx11resources.cpp:158) | 36 | 500 |
| scimitar:DX11WinTexture::GraphicMemTrackerAdd+192B588 (f:\w1\osborn\main\framework\source\scimitar\graphic\gfx\dx11\dx11texture_win.cpp:384) | 28 | 914 |
| scimitar:PhysMemTracker::PlacementAdd+230012 (f:\w1\osborn\main\framework\source\scimitar\system\memory\physmemtracker.cpp:107) | 5648 | 92909 |
| scimitar:IKUtils::AddIKSolveBoneKlob+0xCF | 14145 | 155595 |
| scimitar:NetworkIndicators::GetStatusString+1822FE5 (f:\w1\osborn\main\framework\source\scimitar\onlinemodule\network\private\netservice\displayinterface.cpp:499) | 13363 | 267260 |
| scimitar:PlayerInfoFireDataUpdateItems::PlayerInfoFireDataProvider::2323257 (f:\w1\osborn\main\rainbow\source\scimitar\rainbow\fire\data/provider\playerinfofiredataprovider.cpp:114) | 13360 | 187040 |
| scimitar:Fire_HudMPRoundInfos::DoPrepareFireElementData+292D57A (f:\w1\osborn\main\rainbow\source\scimitar\rainbow\fire\hud\mp\roundinfos\fire_hud\mproundinfos.cpp:323) | 13360 | 387440 |
| scimitar:FirePlayersStatusTeamListDataProvider::BuildPlayerItem+0x2A4 | 12557 | 30689 |
| scimitar:FirePlayersStatusTeamListDataProvider::BuildPlayerItem+0x2D0 | 12557 | 30689 |
| scimitar:SoundVisualEventManager::ProcessConstruct+0x11A | 7208 | 79288 |
| scimitar:SoundVisualEventManager::ProcessConstruct+0x140 | 7208 | 79288 |
| scimitar:SimpleString::TOUTF8SimpleString+1C769E (f:\w1\osborn\main\framework\source\scimitar\system\containers\simplestring.cpp:25) | 5673 | 51647 |
| scimitar:OnlineFileWriterImpl::InternalWrite+1A8436F (f:\w1\osborn\main\framework\source\scimitar\onlinemodule\framework\private\file\onlinefilewriter.cpp:310) | 4933 | 2957705 |
| scimitar:TagValueList::GetTagNames+865327 (f:\w1\osborn\main\framework\source\scimitar\engine\tag\tag.cpp:1990) | 2897 | 93221 |
| scimitar:SoundResources::ToString+0x35 | 2812 | 30608 |
| scimitar:SoundResources::ToString+0x3A | 2812 | 30608 |
| scimitar:SoundInstanceLimiterManager::ProcessConstruct+C14578 (f:\w1\osborn\main\framework\source\scimitar\engine\sound\core\soundinstance\limitermanager.cpp:342) | 2730 | 43680 |
| scimitar:SoundObjectManager::CreateSoundObjectPrivate+89DAEE (f:\w1\osborn\main\framework\source\scimitar\engine\sound\core\soundobjectmanager.cpp:178) | 1668 | 57846 |
| scimitar:FXInstance::Init+F38FE4 (f:\w1\osborn\main\framework\source\scimitar\engine\fx\fxinstance.cpp:368) | 1611 | 39597 |
| scimitar:AIParameter::GetName+12FB557 (f:\w1\osborn\main\framework\source\scimitar\engine\ai\aiparameter\aiparameter.cpp:202) | 1370 | 31830 |
| scimitar:SimpleStringTemplate<char,1>::StartsWith+593611 (f:\w1\osborn\main\framework\source\scimitar\system\containers\simplestring.cpp:258) | 1370 | 16440 |
| scimitar:AIParameters::GetName+0x13C | 1370 | 16760 |
| scimitar:RigidBody::CreateSDKRigidBodyAndAddToWorld+89723F (f:\w1\osborn\main\framework\source\scimitar\engine\physics\rigidbody.cpp:1864) | 1325 | 67138 |
| scimitar:R6DestructionDataNet::Set+2387B90 (f:\w1\osborn\main\rainbow\source\scimitar\rainbow\gamesystems\destruction\r6destructiondatanet.cpp:163) | 716 | 11456 |
| scimitar:DynamicBarkPathData::PathSolver::ResolveModifierRecursively+26D528F (f:\w1\osborn\main\rainbow\source\scimitar\rainbow\ai\barks\barkrequest.cpp:969) | 678 | 2712 |
| scimitar:DynamicBarkPathData::PathSolver::ResolveModifierRecursively+26D52A3 (f:\w1\osborn\main\rainbow\source\scimitar\rainbow\ai\barks\barkrequest.cpp:971) | 678 | 38444 |
| scimitar:SoundLocalizedVoiceManagers::ConstructDebugVoiceRequest+0x20C | 678 | 48614 |
| scimitar:SoundLocalizedVoiceManagers::ConstructDebugVoiceRequest+0x21F | 678 | 48614 |
| scimitar:SoundLocalizedVoiceManagers::PrioritySystems::ExecuteInternal+0x706 | 623 | 27412 |
| scimitar:VoiceDebugger::VoiceRequest::Construct+C3E1D5 (f:\w1\osborn\main\framework\source\scimitar\engine\sound\tool\voicedebugger.cpp:20) | 535 | 25680 |
| scimitar:SoundLocalizedVoiceManagers::ConstructDebugVoiceRequest+1E75F8 (f:\w1\osborn\main\rainbow\source\scimitar\rainbow\sound\soundlocalizedvoicemanager.cpp:490) | 535 | 6465 |
| scimitar:SoundLocalizedVoiceManagers::ConstructDebugVoiceRequest+1E75F19 (f:\w1\osborn\main\rainbow\source\scimitar\rainbow\sound\soundlocalizedvoicemanager.cpp:491) | 535 | 3749 |
| scimitar:SoundLocalizedVoiceManagers::ConstructDebugVoiceRequest+1E75F3A (f:\w1\osborn\main\rainbow\source\scimitar\rainbow\sound\soundlocalizedvoicemanager.cpp:493) | 535 | 17962 |
| scimitar:SoundLocalizedVoiceManagers::ConstructDebugVoiceRequest+1E75F66 (f:\w1\osborn\main\rainbow\source\scimitar\rainbow\sound\soundlocalizedvoicemanager.cpp:494) | 535 | 5350 |
| scimitar:DuplicationManager::DuplicateName+0x78 | 491 | 13329 |
| scimitar:NavigateMoveToDestination::Duplicate+0x264DD (f:\w1\osborn\main\rainbow\source\scimitar\rainbow\ai\entitylogic\navigate\navigatemovetodata.cpp:295) | 468 | 6245 |
| scimitar:DestructionCompoundFragment::AddToWorld+0x1EA | 443 | 33189 |
| scimitar:LocalizationTagConfig::ReplaceTags+AAC0B3 (f:\w1\osborn\main\framework\source\scimitar\engine\core\localizationtagconfig.cpp:492) | 381 | 6343 |

9f662ed0-076a-4e9e-b10c-411125300000

CountersMemoryConnectionsService StatusError List

0000

Connections count 0

Search...

Q

+

+

+

r6_telemetry_logs

12,914,781 hits

Selected Fields

line
file
message
category
username

Available Fields

Popular

_index

tags

thread_id

_id

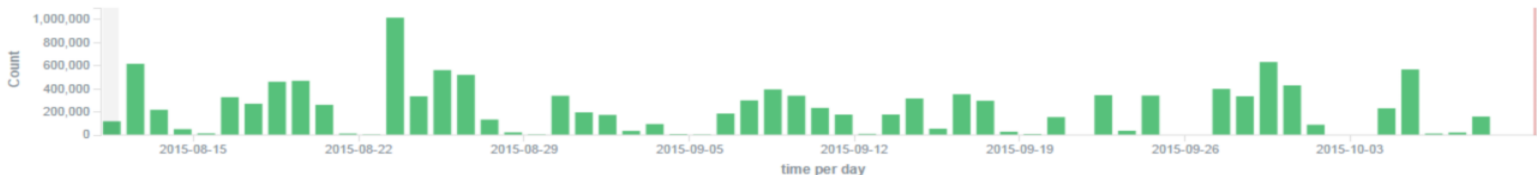
_type

message_string

session_id

time

type

August 12th 2015, 15:43:45.831 - October 11th 2015, 15:43:45.831 — [by day](#)

| Time | message | category | file | line | username |
|--------------------------------|---|----------|--|------|--------------|
| October 9th 2015, 15:14:11.448 | [DisabledComponentUpdated][QueueComponent] Requested update for Component ActiveGroundDrone which was inactive. Owner={object: UNKNOWN id=0xf000a027 class=Entity} | - | - | 0 | mdepascale |
| October 9th 2015, 12:40:19.171 | *****Kino Peak Allocation Type [0] peak allocation [9] waste [247] Type [1] peak allocation [0] waste [8] Type [2] peak allocation [0] waste [0] Type [3] peak allocation [116] waste [4384] Type [4] peak allocation [43] waste [981] | Scimitar | e:\rainbow6\osborn\main\framework\source\scimitar\engine\animation\atom\atominstancepool.cpp | 685 | sorin.ivascu |
| October 9th 2015, 12:40:19.168 | This class has been tagged with the skipreleaseresources mold attribute. ReleaseResources() should not be called. 1. Check if the class should really have this attribute(see programmer guide for guidelines). 2. If still needed, add the attribute to the referenced property. | Scimitar | e:\rainbow6\osborn\main\framework\source\scimitar\engine\debug\replay\debugreplaydebugdisplaytrack.cpp | 731 | sorin.ivascu |
| October 9th 2015, 12:40:18.055 | Shutdown() | Shaders | e:\rainbow6\osborn\main\framework\source\scimitar\graphic\ekion\ekshaderdatabase manager.cpp | 412 | sorin.ivascu |
| October 9th 2015, 12:40:18.051 | Pilot shutdown | Pilot | e:\rainbow6\osborn\main\framework\source\scimitar\engine\ai\pilot\pilotfacade.cpp | 476 | sorin.ivascu |

Telemetry Uses Cases

- Performance Metrics
- Spikes Detection
- Load Time Metrics
- Startup Time Metrics
- Compile Time Metrics
- User Focus Metrics
- Centralized Logs
- Memory Tracking
- Buffers/Pools Size Tracking
- Used Assets/Localization Tracking
- Network Replication Debugging
- Bandwidth/Latency Metrics
- Editor MTBC Stats

PVP Average FPS Leaderboard (last day)

| | | | |
|-------|--------------------|-------------------|---------|
| 44.82 | YACHT | TDM - SECURE AREA | PS4 |
| 47.54 | CLUB HOUSE | TDM - HOSTAGE | PS4 |
| 50.92 | CHALET | TDM - BOMB | PS4 |
| 51.93 | KAFE DOSTOYEVSKY | TDM - SECURE AREA | PS4 |
| 52.13 | KANAL | TDM - HOSTAGE | PS4 |
| 52.39 | HOUSE | TDM - BOMB | PS4 |
| 55.37 | YACHT | TDM - HOSTAGE | PS4 |
| 56.52 | HEREFORD BASE | TDM - BOMB | PS4 |
| 57.40 | HEREFORD BASE | TDM - SECURE AREA | PS4 |
| 59.86 | CONSULATE | TDM - HOSTAGE | XBOXONE |
| 59.98 | CONSULATE | RESCUE HOSTAGE | PS4 |
| 60.47 | HOUSE | HOSTAGE | XBOXONE |
| 60.53 | HEREFORD BASE | SECURE AREA | XBOXONE |
| 60.66 | YACHT | TDM - BOMB | XBOXONE |
| 60.83 | HEREFORD BASE | CONTAINMENT | PS4 |
| 61.23 | YACHT | TDM - HOSTAGE | XBOXONE |
| 61.66 | OREGON | TDM - HOSTAGE | PS4 |
| 61.76 | PRESIDENTIAL PLANE | SECURE AREA | XBOXONE |
| 61.88 | CHALET | RESCUE HOSTAGE | PS4 |
| 62.32 | KANAL | TDM - BOMB | PS4 |
| 62.74 | PRESIDENTIAL PLANE | TDM - SECURE AREA | PS4 |
| 62.80 | OREGON | SECURE AREA | XBOXONE |

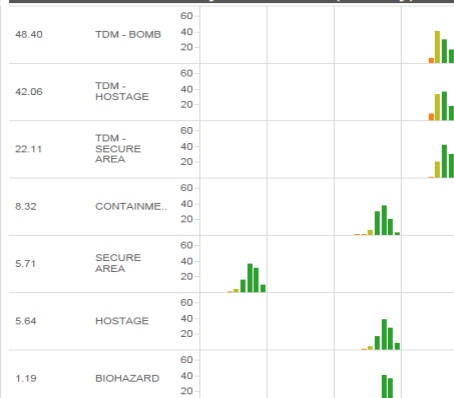
Percentage of Frames below 60 FPS Leaderboard (last day)

| | | | |
|-------|--------------------|-------------------|---------|
| 97.98 | HOUSE | TDM - BOMB | PS4 |
| 95.65 | CLUB HOUSE | TDM - HOSTAGE | PS4 |
| 90.90 | YACHT | TDM - SECURE AREA | PS4 |
| 89.24 | KAFE DOSTOYEVSKY | TDM - SECURE AREA | PS4 |
| 83.80 | HEREFORD BASE | TDM - BOMB | PS4 |
| 74.97 | HEREFORD BASE | TDM - SECURE AREA | PS4 |
| 73.99 | KANAL | TDM - HOSTAGE | PS4 |
| 62.70 | CHALET | TDM - BOMB | PS4 |
| 54.79 | YACHT | TDM - HOSTAGE | PS4 |
| 51.14 | OREGON | TDM - HOSTAGE | PS4 |
| 48.40 | YACHT | TDM - BOMB | XBOXONE |
| 46.56 | KANAL | TDM - BOMB | PS4 |
| 44.70 | CONSULATE | TDM - HOSTAGE | XBOXONE |
| 42.06 | YACHT | TDM - HOSTAGE | XBOXONE |
| 40.80 | PRESIDENTIAL PLANE | TDM - SECURE AREA | PS4 |
| 34.73 | KAFE DOSTOYEVSKY | TDM - BOMB | PS4 |
| 33.53 | HEREFORD BASE | TDM - HOSTAGE | XBOXONE |
| 33.18 | HOUSE | HOSTAGE | XBOXONE |
| 32.28 | KAFE DOSTOYEVSKY | TDM - SECURE AREA | XBOXONE |
| 31.28 | CONSULATE | RESCUE HOSTAGE | PS4 |
| 28.54 | KAFE DOSTOYEVSKY | TDM - BOMB | XBOXONE |
| 26.60 | BANK | TDM - HOSTAGE | PS4 |

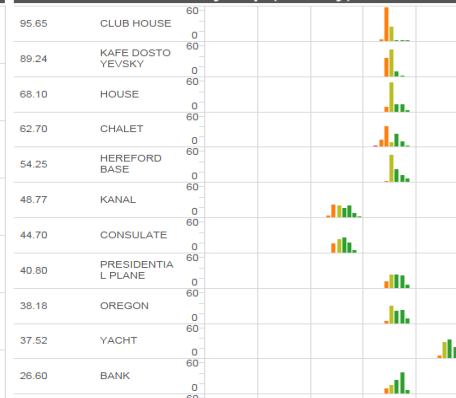
PVP FPS Distribution by Platform (last day)

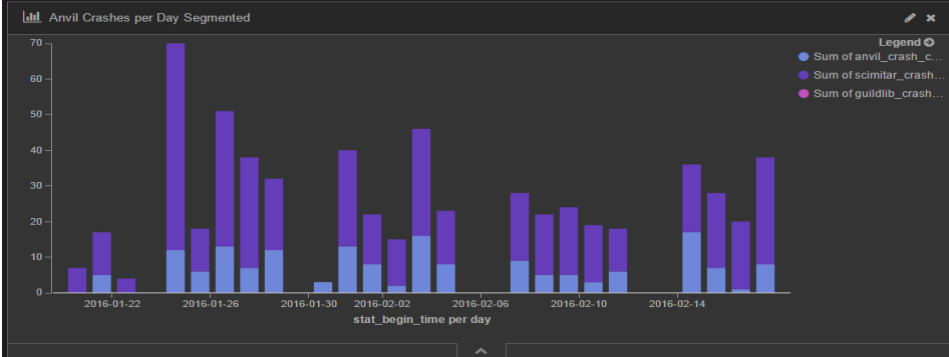
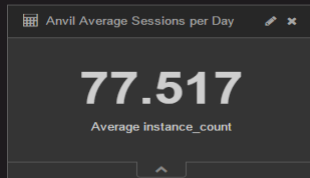
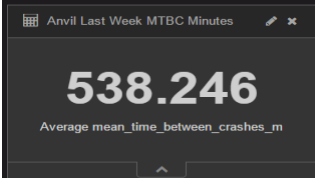


PVP FPS Distribution by Game Mode (last day)



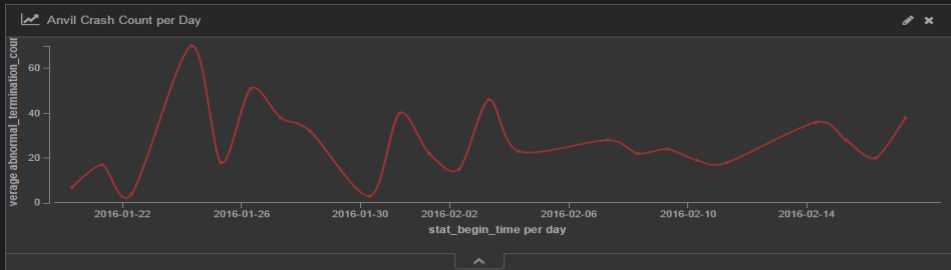
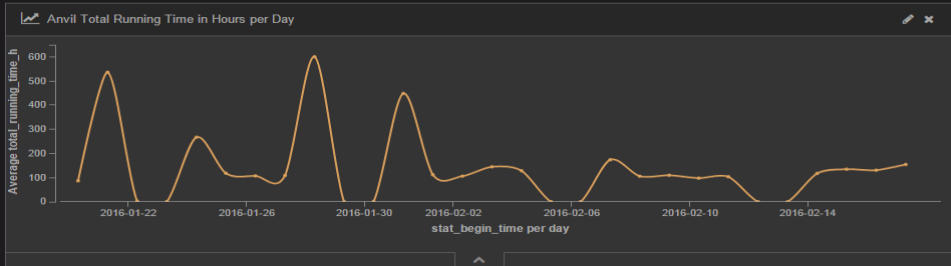
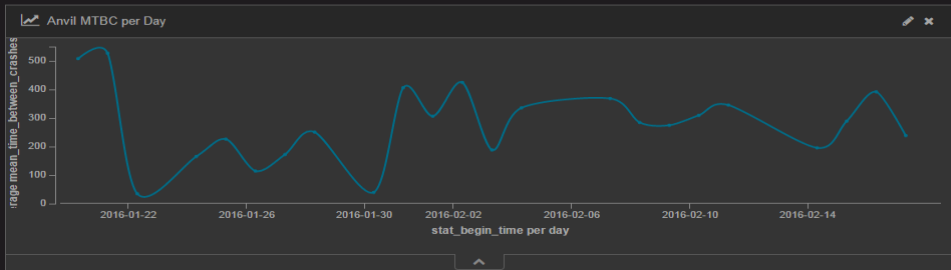
PVP FPS Distribution by Map (last day)





</> Anvil Global Dashboard Legend

The Anvil MTBC is computed with the running time capped to 8 hours and includes the Scimitar Toolmode and Guildlib crashes.



Agenda

- Intro
- Unified Telemetry Rationale / Design
- Rainbow Six Siege Telemetry
- Postmortem
- Q&A



Definition of Telemetry

“Telemetry is the highly automated communications process by which measurements are made and other data collected at remote or inaccessible points and transmitted to receiving equipment for monitoring.”

source: Wikipedia

Definition of Telemetry

“*Telemetry* is the highly automated communications process by which measurements are made and other data collected at remote or inaccessible points and transmitted to receiving equipment for monitoring.”

source: Wikipedia

Use Cases

- Stats Gathering
- Events
- State Snapshots
- Live Debugging



Current Tech

- Logging Systems (file)
- Tracing Libraries (file)
- Metrics Collection (network)
- Memory Profilers (file)
- Performance Profilers (file)
- Physics Debugger (live tool)
- Animation Debugger (live tool)



The Need for Unified Telemetry

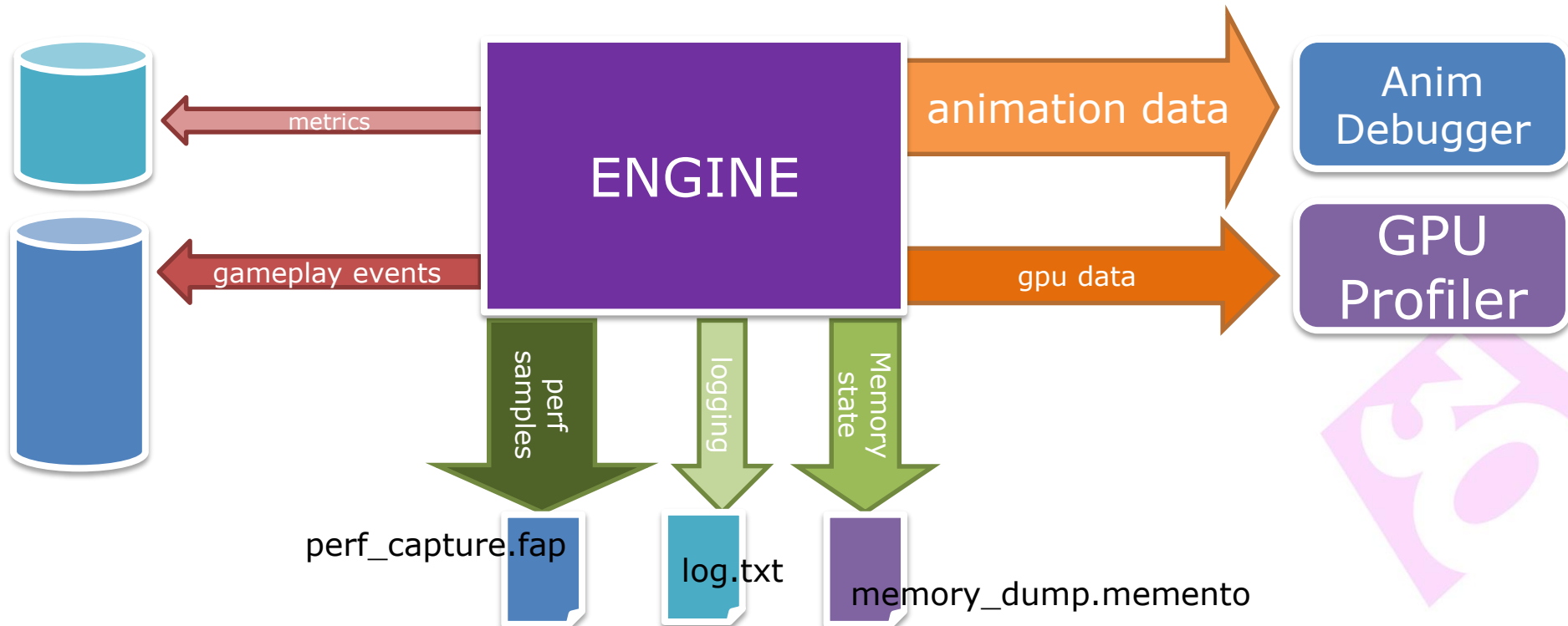
Scattered Tools

Scattered Data

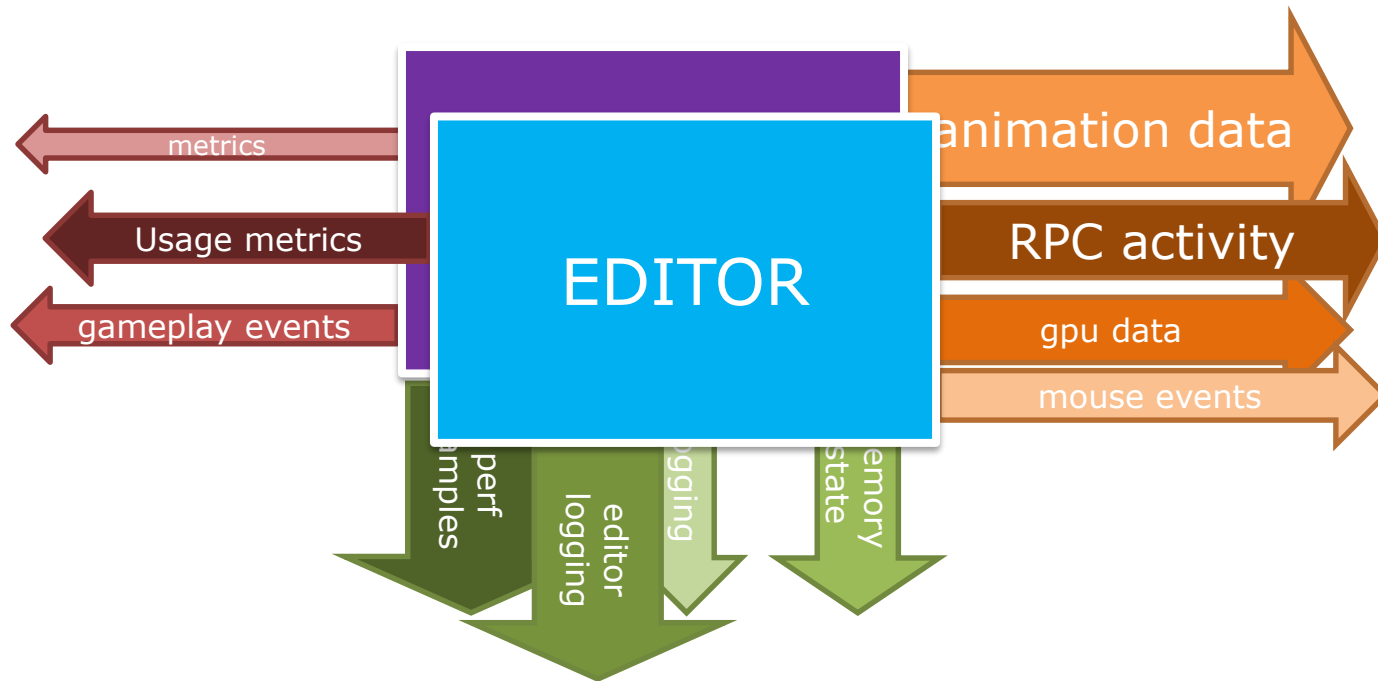
Scattered Knowledge



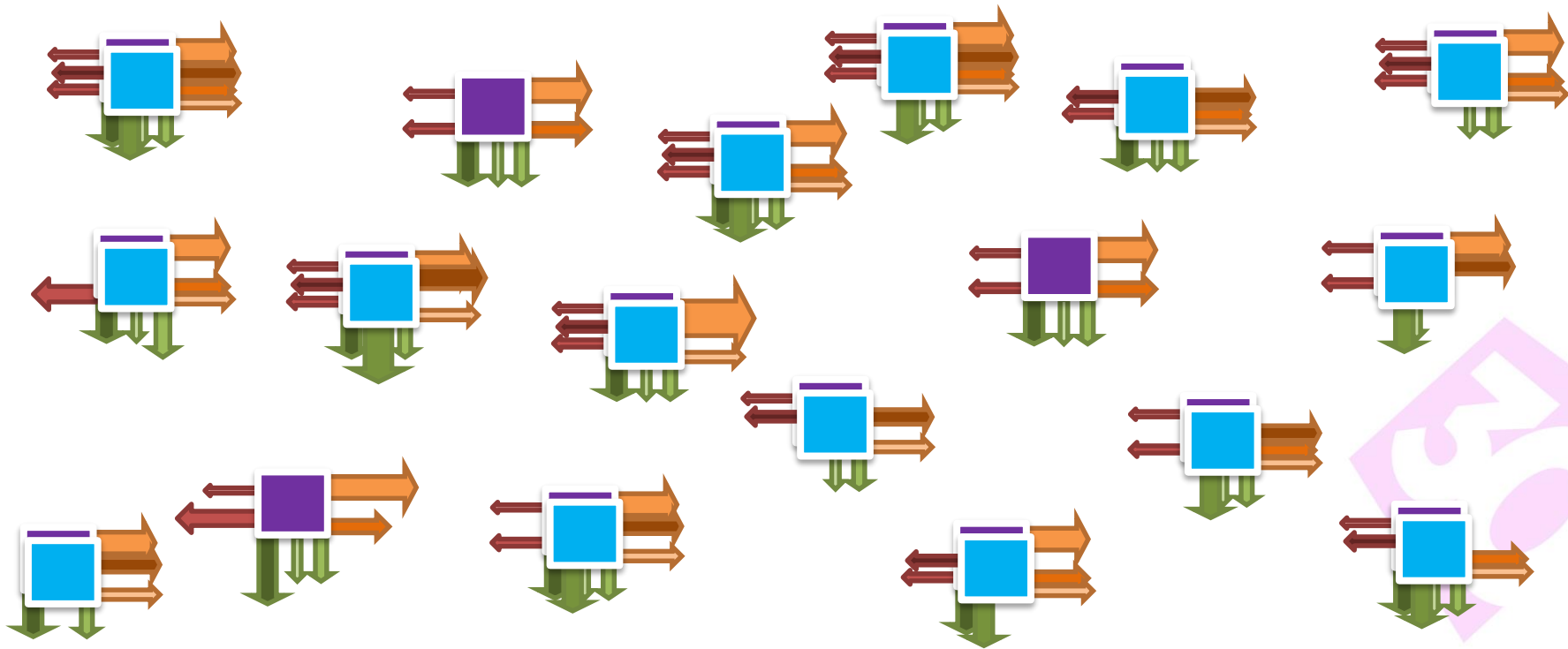
Non Uniform Telemetry Data



Multiple Processes



Large Teams / Multisite Develop



Unified Telemetry

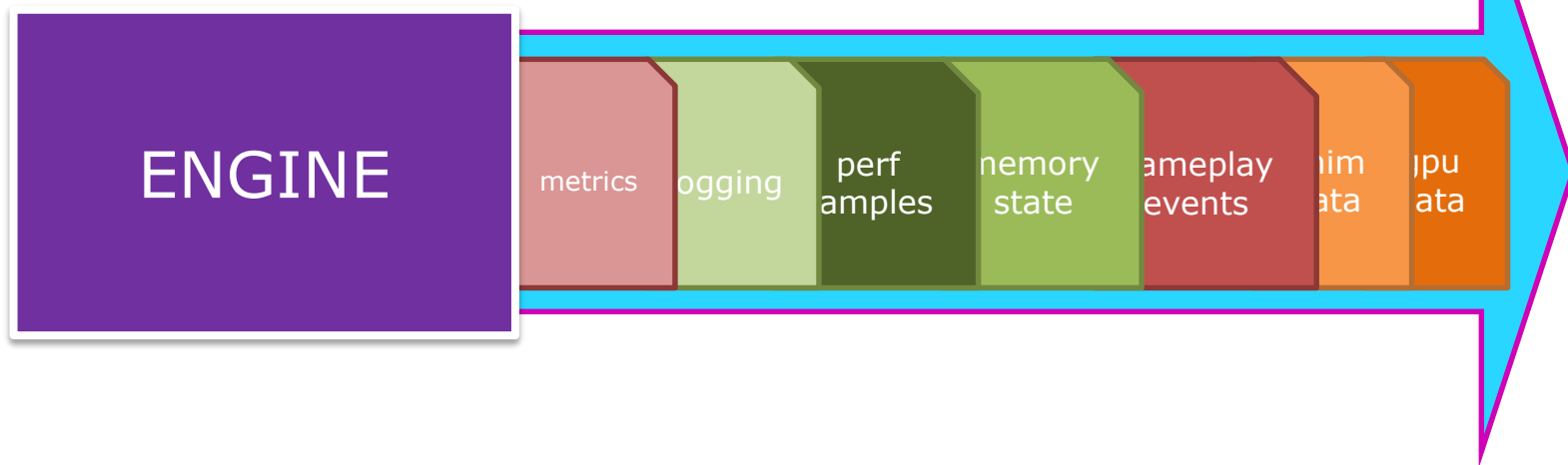


Unified Telemetry

1. A single pipe for all telemetry data



Unified Telemetry Stream

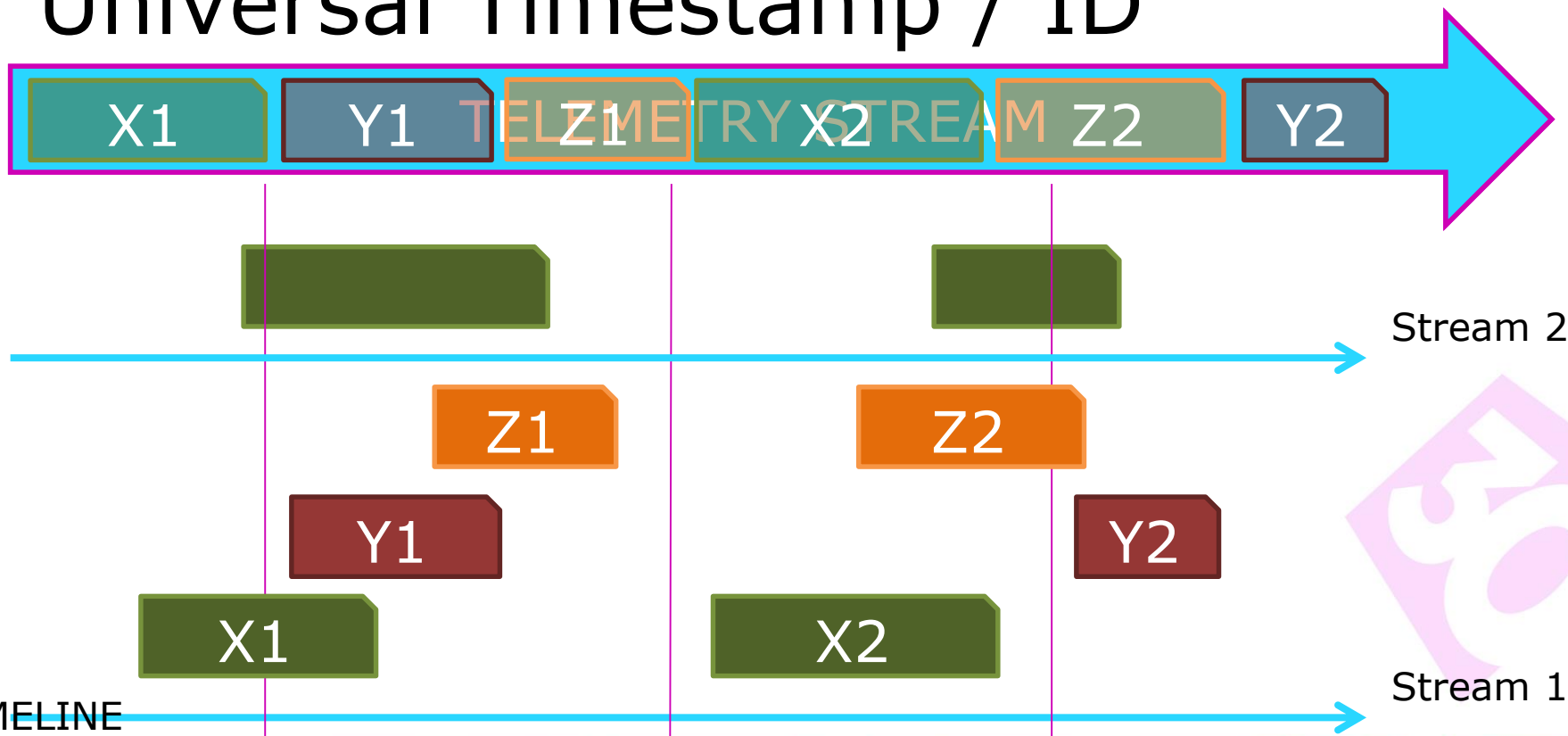


Unified Telemetry

1. A single pipe for all outgoing telemetry data
2. Universal timestamping / ID



Universal Timestamp / ID

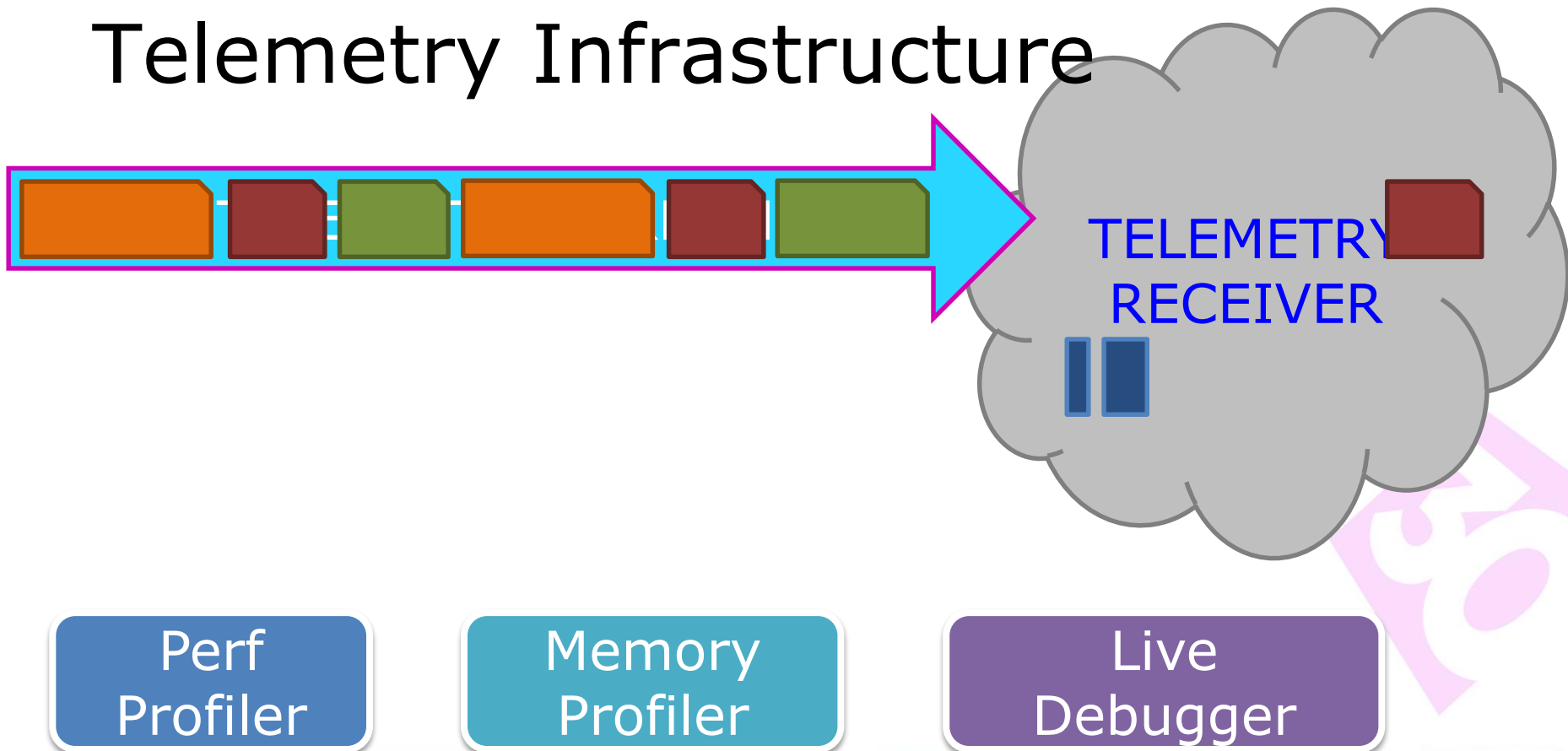


Unified Telemetry

1. A single pipe for all outgoing telemetry data
2. Universal timestamping / ID
3. A scalable infrastructure to
 1. Collect
 2. Process (Custom)
 3. Store
 4. Retrieve



Telemetry Infrastructure



Current Tech, Extended

- Logging Systems (telemetry, file)
- Tracing Libraries (telemetry, file)
- Metrics Collection (telemetry, network)
- Memory Profilers (telemetry, file)
- Performance Profilers (telemetry, file)
- Physics Debugger (telemetry, live tool)
- Animation Debugger (telemetry, live tool)

Benefits

- Simpler Tools
- Cross Domain Analysis
- Team Wide Analysis of non-stats Data
- Easier Collaboration



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Telemetry Stream

Lossless
Ordered
Stream of
Heterogeneous
Binary Encoded
Events



C++ Client

- Layered
 - Engine/platform agnostic base (C++11)
 - Engine/Platform integration code (PC, PS4, XB1)
- Completely Passive
 - No memory allocations
 - No implicit I/O
- Modular & Configurable
 - Runtime Bit Mask per class of events



Telemetry Primitives

- Counter
- Value
- Constant
- GraphSettings
- Marker
- Scope
- Log
- BinaryData
- TextData
- SendFile
- Task
- Resource
- ProcessInfo
- ...



Telemetry Primitives (Scimitar)

- CPU Frame
- GPU Frame
- Engine Update
- Graphics Update
- ProfilerStreaming
- MemoryEvent
- UserInfo
- CodeDataSound
- Tainted
- ...



Telemetry Primitives (Rainbow6)

- Match
- Round
- Map
- GameMode
- GameType
- GameplayEvent
- LocalizationEvent
- ...



C++ API Usage Examples

```
//track destructible entities creation
TELEMETRY_HI_FREQ_COUNTER("[Engine][EntityCreate] scimitar::DestructibleComponent");

//Generate Graph data for latency
TELEMETRY_GRAPH_SETTINGS("Name=latency; Unit=ms; Color=red; Group=Network;");
TELEMETRY_VALUE("latency", sampledLatency);

//Record connected user
TELEMETRY_MARKER_FORMAT("[Gameplay][Network] user connected {0}", username);

//Track loading time for maps
{
    TELEMETRY_LOW_FREQ_SCOPE_FORMAT("[Loading] Map {0}", mapName);
    FastLoadData(mapName);
}
```

C++ API Usage Examples

```
//Save profiler snapshot and collect file centrally
```

```
auto&& const filename = Profiler::GetFilename();
```

```
Profiler::SaveToDisk(filename);
```

```
TELEMETRY_SEND_FILE(filename);
```

```
//Record settings after recursive inclusion of all ini files
```

```
TELEMETRY_TEXT_DATA( "IniSettings", settings.ToString() );
```

```
//Send Begin/End Frame Markers
```

```
SCIMITAR_TELEMETRY_BEGIN_CPU_FRAME(frameNumber);
```

```
SCIMITAR_TELEMETRY_END_CPU_FRAME();
```

```
//Send Gameplay specific info
```

```
R6_TELEMETRY_BEGIN_ROUND(mapName);
```

```
R6_TELEMETRY_END_ROUND();
```



C++ Client Initialization

- Init
 - Very first line in main()
 - Uses provided temporary buffers
- Connect
 - Called after engine has been initialized
 - Establishes connection (or setup file output)
 - Flushes data and switches to normal behavior

C++ Client Performance

- Queues of buffers
 - 16MBs Total for RainbowSix
- Lockless access to buffers
 - Uses a Read-Copy-Update strategy
- Hierarchy of TLS buffers
 - When global ordering is irrelevant
- Ammortized Cost per Global Primitive:
 - RDTSC + 3 CMPXCHG + REP MOV



C# Client

- A Mirror of the C++ API
 - Less performance obsessed
- Pure C#
 - no P/Invoke
 - no managed C++
- Supports Async Data Transfer
- Uses [Conditional] to be compiled out

C# API Usage Examples

```
//Collect file
```

```
Telemetry.SendFile("user.ini");
```

```
//track focus switch
```

```
Telemetry.Counter("[Anvil][Tool] Focus Switch", +1);
```

```
//Record events
```

```
Telemetry.Marker("[Anvil][Tool] Plugin {0} Loaded", pluginName);
```

```
//Track loading time for maps
```

```
using( Telemetry.TimingScope("[Anvil][Loading] Map {0}", mapName) )
```

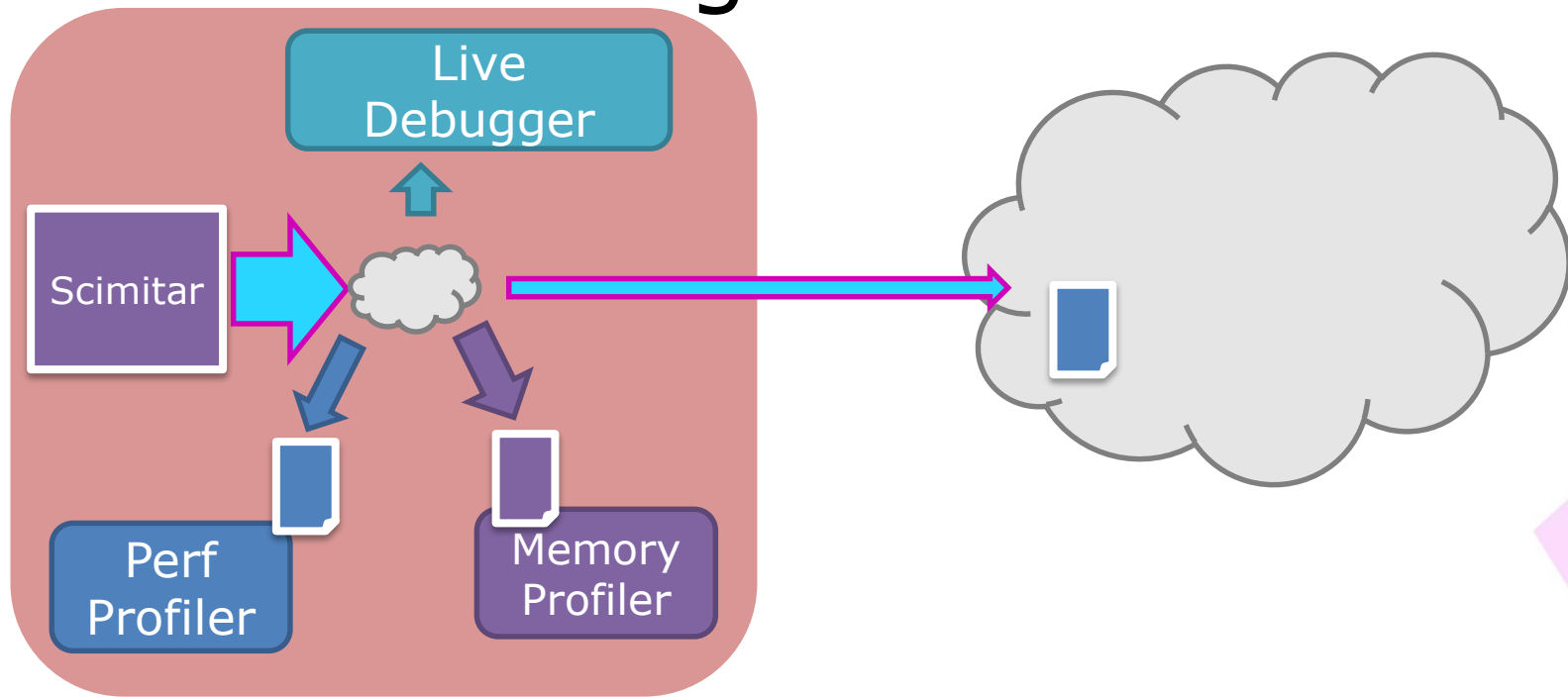
```
{
```

```
    Scimitar.LoadWorld(mapName);
```

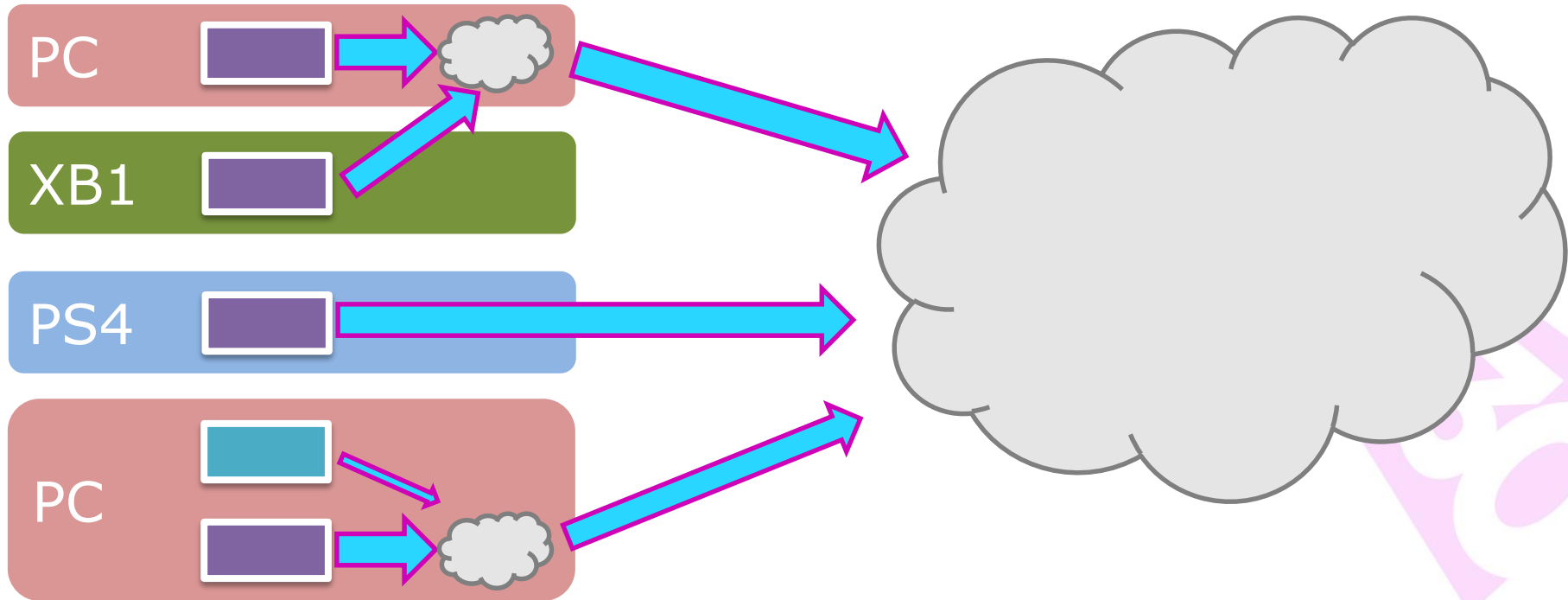
```
}
```



Network Usage



Adaptive Scalability



Telemetry Receiver

- Receives data fast
 - to avoid buffer overruns on client
- Dispatches deserialized data to Processors
- Used as
 - Local Receiver
 - Global Receiver

Telemetry Processors

- Aggregate Data
- Analyze Data
- Transform/Forward Data to visualizers
 - (e.g. Local Tools)
- Store Data into DB



C# Processor Examples

```
public class CountersStreamProcessor : TelemetryStreamProcessor
{
    void OnEvent(StreamOpenEvent evnt, Guid guid) ...
    void OnEvent(EndOfPrologueEvent evnt, Guid guid) ...
    void OnEvent(StreamClosedEvent evnt, Guid guid) ...
    void OnEvent(ProcessInfoEvent evnt, Guid guid) ...
    void OnEvent>AnvilInfoEvent evnt, Guid guid) ...
    void OnEvent(ScimitarInfoEvent evnt, Guid guid) ...
    void OnEvent(EndOfProcessingEvent evnt, Guid guid) ...
    void OnEvent(RecordNameMappingEvent evnt, Guid guid) ...
    void OnEvent(CounterEvent evnt, Guid guid) ...
    void OnEvent(RecordSlotMappingEvent evnt, Guid guid) ...
    void OnEvent(HighFrequencyCountersEvent evnt, Guid guid) ...
    void OnEvent(BinaryDataEvent evnt, Guid guid) ...
    void OnEvent(TaintedDataEvent evnt, Guid guid) ...
}
```



Scalability

- Optional Local Telemetry receiver
- Global Telemetry receivers
- Centralized NoSQL Database



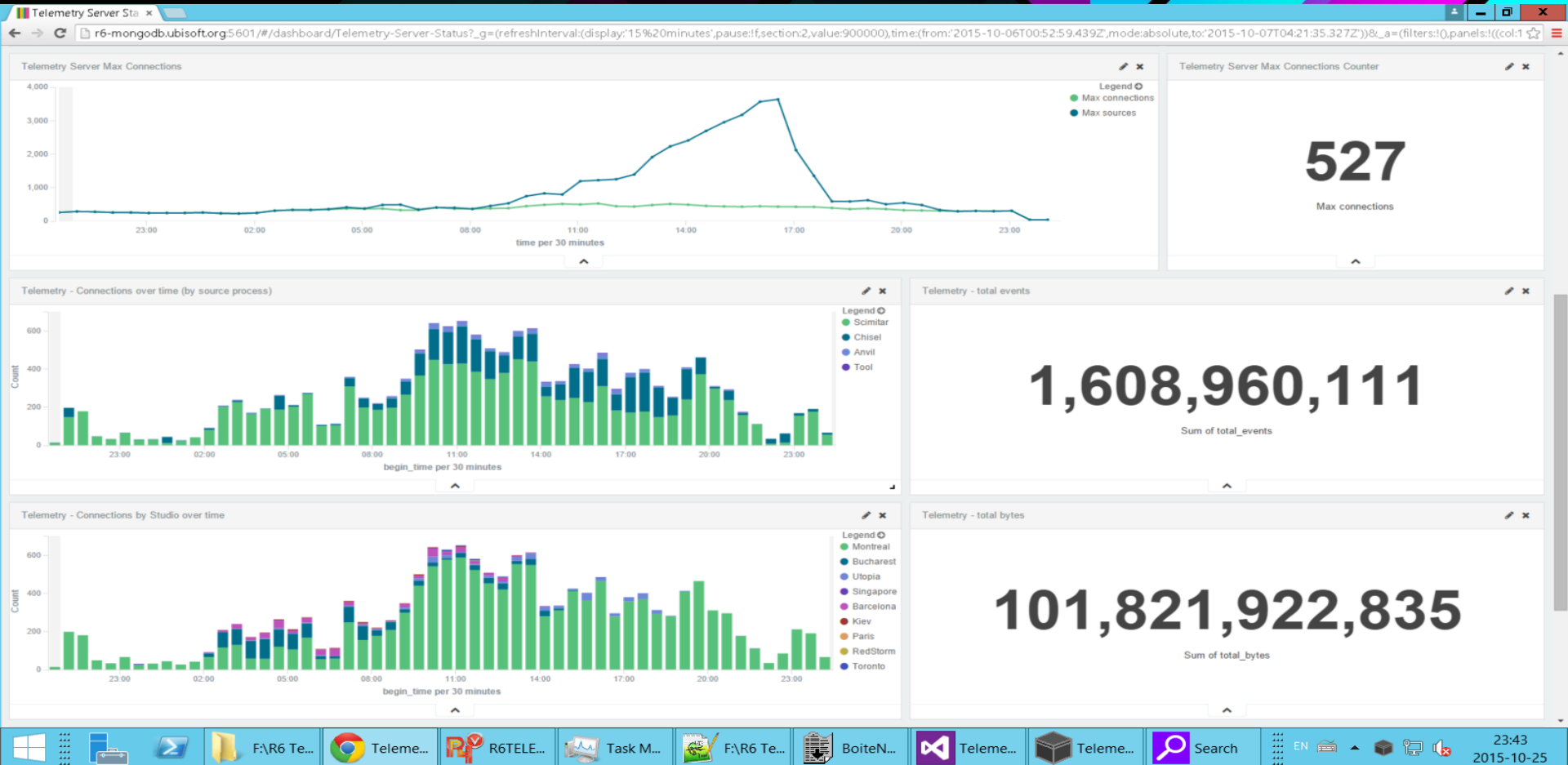
Infrastructure Performance

- Local Telemetry Receiver
 - Real-time processing on typical workstation under typical load (i.e. 1 Editor, 1 Engine)
- Global Telemetry Receiver
 - But more streams (500~1000 on Rainbow Six)
 - Up to 30~60 minutes behind, during busy periods
 - Peak on Rainbow Six: 300+ GBs / day

Hardware Spec

- Intel XEON
- E5-1650 v2 @ 3.50 Ghz
- 32/64 GB RAM



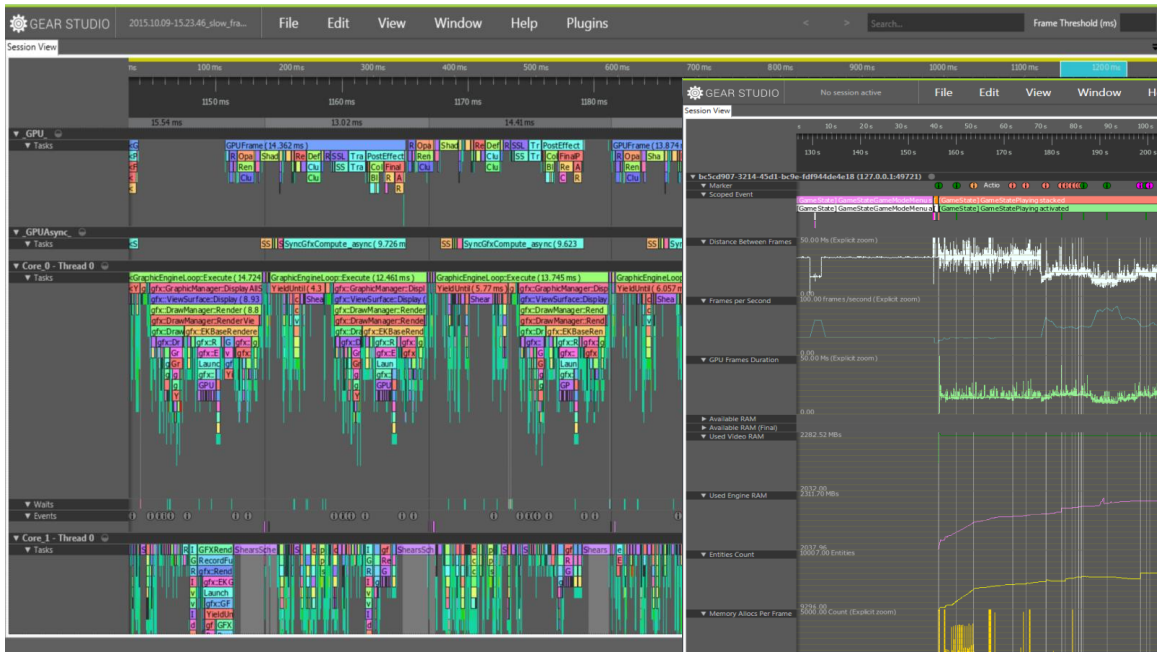


Data Visualization

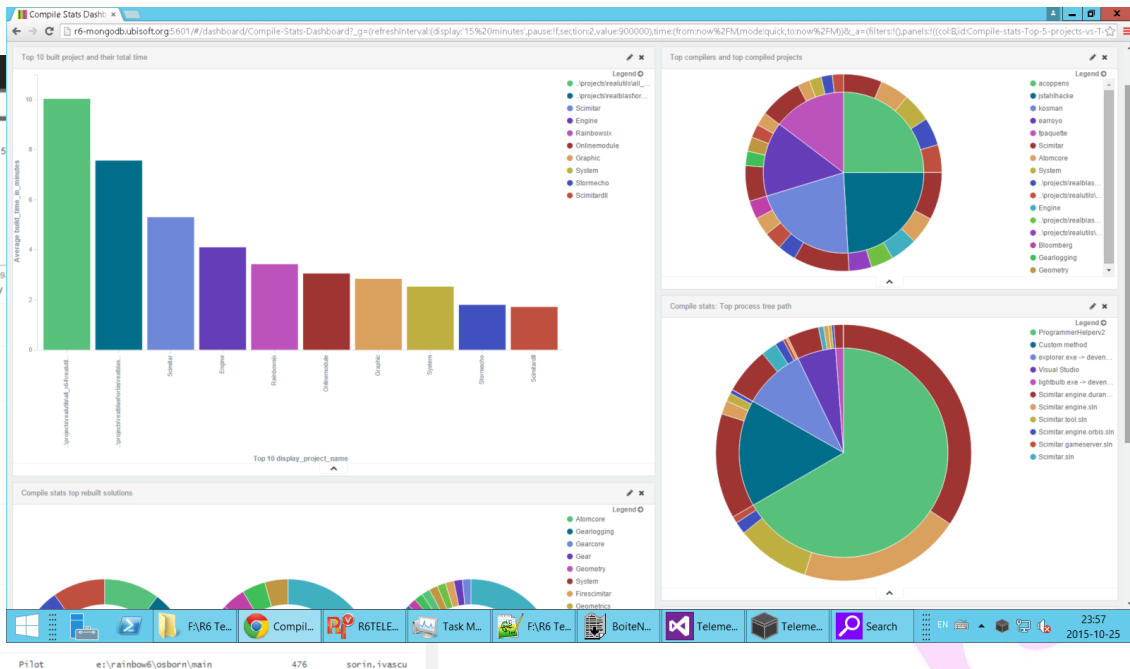
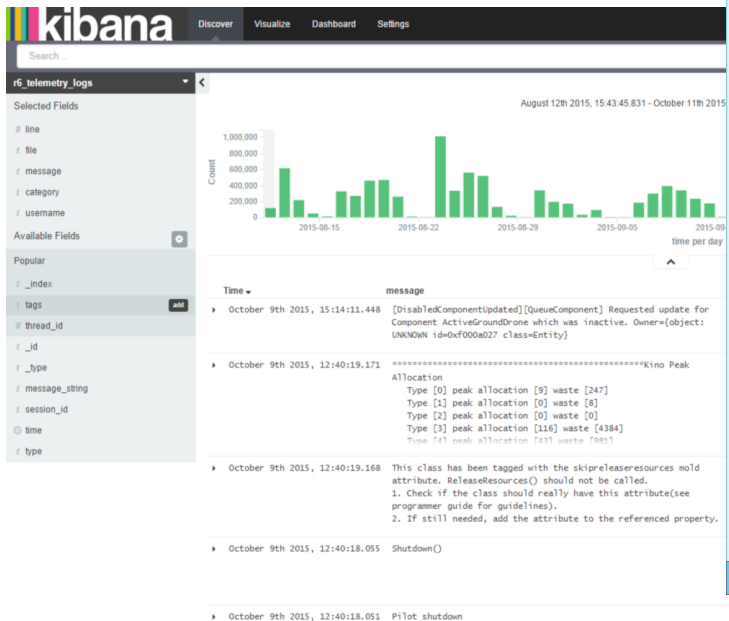
- Custom Tools
- Kibana
- Tableau
- Custom Web Interface



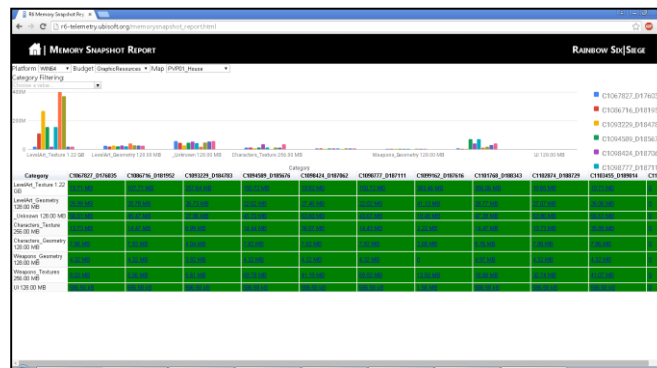
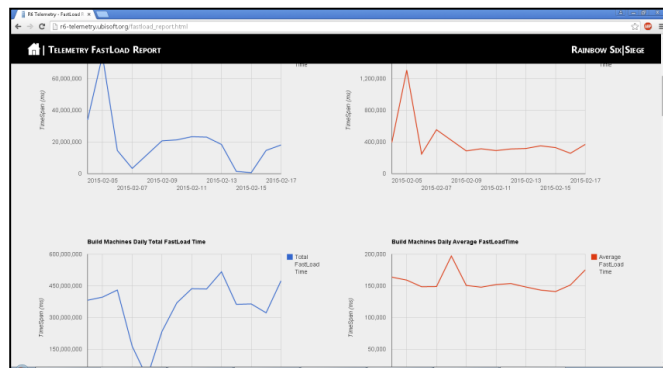
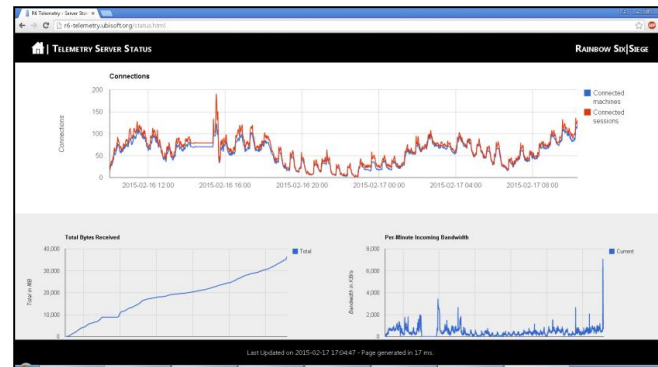
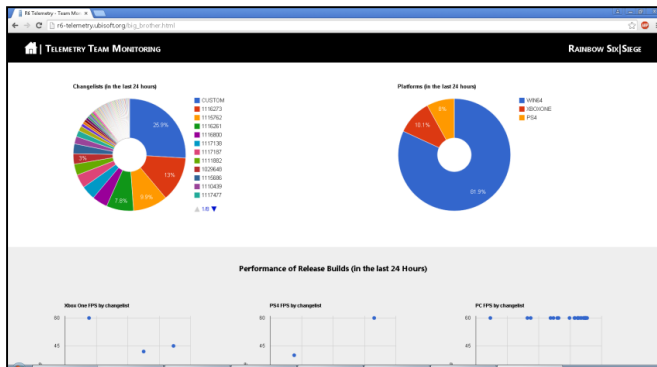
GearStudio



Kibana



Web Interface



Centralized Data Storage

- MongoDB



- main storage, documents and files (GridFS)

- Elasticsearch

- replicated data, consumed by Kibana



elasticsearch

Offline Support

- Just save to disk in a receiver is not available
- e.g. XLC
- Each Receiver can load and process offline streams



Wire Protocol

- Binary Encoded
 - Memcpy, no endian-swap on x64
- Frames (MessageID, Length, Payload)
 - Can skip unsupported events
- Timestamps not part of the protocol
 - Even though is in almost every message type
- Supports 7bits encoding
 - But we never had to use it

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- Startup Time Metrics
- Compile Time Metrics
- User Focus Metrics
- Centralized Logs
- Memory Tracking
- Buffers/Pools Size Tracking
- Used Assets/Localization Tracking
- Network Replication Debugging
- Bandwidth/Latency Metrics
- Editor MTBC Stats

Postmortem (Pro)

- Simpler Tools
- Data Cross Correlation
- More Effective Collaboration

Go get a Unified Telemetry System!



Postmortem (Fails)

- Sockets
 - Lesson Learned: don't use blocking sockets from non-background threads
- Optional Timestamp
 - Lesson Learned: bandwidth never an issue, add timestamp to protocol
- C# Server
 - Lesson Learned: overspec for memory
- Servers Hardware Setup
 - Lesson Learned: don't run out of space on Mongo



Postmortem (Reccomendations)

- Know your Questions before Tracking
 - Tracking is costly. Only do it if necessary
- No Tracking without Owner (not you)
 - Both tracking and data rots quickly
- Having Data is good
 - Having too much data is bad
 - Having bad data is a dangerous



What's Next

- Stress tested in full production cycle
 - Rainbow Six Siege
 - Unannounced Project
- Close the loop
 - Record/Replay/Automated Testing
- Internal Network Only
 - yet multisite (North America, Europe, Asia)
 - Would it work on the Internet?



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Thank You!



Questions?

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